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PRESENT DAY STATUS OF CHEMISTRY AND TECHNOLOGY OF PETROLEUM IN CHINA

-Communist China-

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In old China the petroleum industry was not adequately developed. Very few oil fields were found, and the equipment and production techniques were obsolete. From the time that the first well was put into production in 1907 to 1948, i.e. in 42 years, the total crude oil production in China was only 2.78 million tons. The range of petroleum products was very narrow; most of them were imported from abroad. The maximum annual production of crude oil did not exceed 319,000 tons (1943). On the eve of liberation, the annual production for the country was only 70,000 tons.

Under the conditions of old China, scientific research on the refining of oil could not be developed. A small group of scientists was busy working in the field of petroleum substitutes such as vegetable oils and the semi-coking of solid fuels. The experimental equipment was primitive, and practical results were very few.

A great change took place in the development of the petroleum industry after the liberation of China and the creation of Chinese People's Republic. The known oil basins, such as the Yu-nen and Yen-shan, have been constantly extended and new ones have been discovered, such as the Karamai, Szechwan, and Tsaidam.

Old refineries have been reconstructed and ten new refineries and synthetic liquid fuel plants have been built. The 1959 petroleum production was seven times greater than in the best pre-liberation years. The bulk of the equipment for new plants (up to 90%) has been built in China by Chinese.

Under the direction and with the support of the Communist Party of China and the People's Government, scientific research in petroleum and its refining is developing. Work has begun on the analysis of oils from various fields, on new methods of studying petroleum and its products, and on standardization of these methods. At the same time, extensive study has been done on the evaluation of basic resources of petroleum and oil shale.

In recent years petroleum scientists have introduced such delicate methods of petroleum analysis as rectification, chromatography, spectremetry, and others. Extensive research in fluid chromatography, volume, gas-liquid, and thermochromatography, has yielded results important not only for theoretical study of chromatographic differentiation, but also for industrial practice.

These methods and combinations with others have been used in the development of group analysis of a number of oils and shale oil. Approximately 80 individual hydrocarbons have been identified in the benzine fraction of the Karamai crude, and 20 phenol and pyridine compounds in a light fraction of shale oil. The results of this work are a basis for a rational utilization of the stores of hydrocarbons and other compounds.

Extensive research is underway for the development of new refining methods for petroleum and shale oil. Plans which are based on modern refining methods already have been worked out for refining the Fushun' shale oil and Karamai petroleum.

Extensive study has been carried out on aromatization of synthetic products of water gas; catalysts have been successfully selected and a scheme for product breakdown has been developed. In 1955, a plant was built on the basis of this study; it is now in operation.

Much effort has been expended by petroleum scientists in working out the platforming process in obtaining high octane benzine and chemical raw materials of an arommatic series, and in selecting a satisfactory catalyst and methods of refining the derived products. This process is to be introduced soon in industry. In 1958 a highly effective reforming catalyst was synthetized which makes it possible to increase the productivity of installations four to six times. Studies are underway for obtaining effective catalysts in catalytic cracking.

Research is proceeding satisfactorily on the physical and chemical desalting of crude oils to prevent corrosion of refining installations. A number of institutes and plants are carrying on research in carbamide deparaffinization of petroleum products. It has been demonstrated that this deparaffinization method is applicable in the production of aviation kerosene and high-grade lubricating oils. The development of a powder coking process is underway; it will raise the yield of ligh-colored products.

In old China lubricating oils and consistent lubricants were imported from abroad. Thanks to the intensive, co-ordinated efforts of scientists and industrial workers, the production of domestic lubricants was organized soon after the reconstruction of the state economy in the CPR. Successful experiments are underway for obtaining lubricants effective at high pressures and temperatures and under other rigorous conditions. Their industrial production is being organized.

The dry distillation of shales is an important source of shale oil; however, for a long time the efficiency factor in dry distillation has been very low. Scientists and engineers of new China studies in detail and improved the design of the semi-coking furnace; as a result, its converting capacity has increased about 15%, with the shale oil yield increasing 20%. In 1958 a new model of a gas-operated semi-coking furnace was developed. It will increase the productivity of the semi-coking process.

Various refining processes have been worked out for shale oil in order to obtain a synthetic liquid fuel. The process of hydrogenation of the heavy fraction of shale oil at high pressure and in the presence of a molybdenum catalyst has been operative in industry. For new enterprises, two ways have been worked out for refining shale oil to obtain high quality lubricating oil, diesel fuel, and other products.

Petroleum scientists of China are confronted with a new and important problem: the processing of coal tar. Deposits of tar-containing coals (with a tar yield of 10-40%) occur in almost all provinces of China. In the future tar production will grow. It is proposed to refine this tar by high pressure hydrogenation, wherein up to 90% of asphaltenes are converted. This process is already in industrial use. Also being worked out is a medium pressure (70 atm) hydrogenation process wherein the tar yields simultaneously about 20% light phenols, as well as an aviation kerosene which corresponds to the standard.

After the birth of the CPR, petroleum scientists and workers rebuilt the water gas synthetic fuel plant destroyed by the Japanese; they have achieved great success in producing the initial gas and catalyst, and in mastering the synthetic process. At the present time, a new and more effective process has been developed, wherein the synthesis of liquid fuel is achieved in a psuedoliquified layer of the molten iron catalysts. In this process the products' yield is as much as 191 g/m^3 of gas. An experimental plant has been built for the synthesis of liquid fuel and chemical products obtained by this method.

In connection with the development of oil refining and the synthetic liquid fuel industries, experimental laboratories continue the work of synthesis of many catalytic agents and improve their production methods. As a result, the effectiveness and selective action has been raised for many catalysts, including those used in reforming, hydrogenation, synthesis, etc.

A detailed study has been done at the same time on catalyst carriers: diatomaceous earth, clay activated coke, aluminum oxide, silica gel, etc. Study has been initiated on fundamental regularities in catalytic processes and on the synthesis of catalysts. For instance, the effect of the formation of cobalt silicate on the pore structure of a catalyst and the chemosorption energy has been determined for the synthesis of cobalt catalyst from water gas. The bifunctional aspect of metal and acid centers has been determined for the platforming catalyst. For the synthetic alumosilicate catalyst in catalytic cracking research has been carried out on determining the lack of homogeneity in active surfaces; also, the part of nitration and promotion of molten iron catalyst has been established, along with the nitrogen stability mechanism for a catalyst in hydrogenation and catalytic cracking. These theoretical studies, in conjunction with practical experience, make it possible to initiate the building up of a scientific basis for the selection of catalysts.

The chemico-technological processes of fractionation, such as distillation, extraction, etc, are important for obtaining chemical raw materials from natural petroleum products. Modeling is widely used in the study of these and other processes. Gas-liquid equilibrium and the efficiency of different columns were studied for fractionation of aromatic hydrocarbons

obtained in aromatization of synthetic products of water gas and platforming, and for separating oxygen-carrying compounds from hydrocarbons obtained in the refining of shale oil and in the synthesis of water gas; this has played an appreciable part in the solution of practical problems. Extensive experiments are underway on modeling and studying processes with a boiling layer of the catalyst or heat-carrier (medium pressure synthesis from water gas, etc). As a result, a store of scientific experience has been acquired for the development of industrial processes.

Problems of heat and mass transfer in a contact reactor with the stationary layer, and the principles of its technological designing are of great importance in chemical technology. Work has been done in the CPR in recent years with electric models on determining heat transfer in a stationary layer and on the study of the layer's resistance. This work has yielded interesting data for technological planning.

The method of direct electric modeling is based on modern computing technique; it has been successfully used in chemical technology in the solution of some complex problems such as that of unstable heat transfer, calculation of the discharge curve in chromatography, fractional distillation of multicomponent fractions, etc.

Such rapid progress of petroleum scientists in New China has been achieved thanks to proper guidance of the Communist Party of China. The Party, in co-ordinating scientific work and industrial construction, has brought together science and the people. The Party, armed with Marxist-Leninist doctrine, foresaw the great potential in the development of science in China, and has successfully organized the work of scientists in New China. The Party slogan, "Let 100 Schools of Thought Contend," encourages the creative ability and initiative of our scientists and promotes the scientific progress of our country.

One of the important factors in the immense achievements in the field of chemistry and technology of petroleum in our country is scientific and technical assistance by the Soviet Union and other socialist countries.

The Soviet Government and Soviet scientists are helping us organize scientific study, build up equipment and installations, and train our personnel. They also share with us their rich experience. We, Chinese petroleum scientists, cordially thank them for this assistance.

Scientific research of petroleum in China is far from satisfying the demands for building up socialism. Indeed, we started our work decades later than the technically advanced countries. Our ranks of scientific petroleum workers are not strong enough to tackle any important and complex industrial task. We hope, however, that the problems facing us will be solved successfully, in friendly co-operation with scientists of the Soviet Union and other democratic countries.

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